DOCUMENT RESUME

ED 297 316 CS 210 098

AUTHOR Langer, Judith A.

TITLE Writing to Study and Learn.

INSTITUTION Stanford Univ., Calif. School of Education.

SPONS AGENCY National Inst. of Education (ED), Washington, DC.
PUB DATE [86]
GRANT NIE-G-82-0027
NOTE 58p.
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS *Content Area Reading; *Content Area Writing; High Schools; Information Processing; Learning Activities; *Learning Processes; *Reading Comprehension; Reading Research; Reading Writing Relationship; *Recall (Psychology); *Study Skills; Writing Research
IDENTIFIERS *Writing to Study

ABSTRACT

Two studies examined the effects of writing on subject learning. For the first study, 322 ninth and eleventh grade students read passages from high school social studies and science texts and engaged in six writing-to-study conditions. Students who wrote essays scored lower on immediate topic knowledge posttests, while the students who used study methods other than essay writing had the greatest gains on the immediate posttest, but also the greatest falling off at the 4-week posttest. The second study focused on the relationship between what writers do during different writing tasks and recall. Ninth and eleventh graders (N=110) read two passages from the first study and engaged in four writing-to-study tasks. Findings indicated that the writing conditions led to greater recall of content than the non-writing condition, and that the more the content was manipulated during writing, the better it was recalled. Together, both studies indicate that tasks such as question answering and notetaking involve a superficial manipulation of content and lead to extensive but short-lived learning, while the analytic writing tasks involve a greater depth of processing and lead to longer term learning of a smaller band of information. (Author/SRT)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED297316

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

Writing to Study and Learn

Judith A. Langer
School of Education
Stanford University
Stanford, CA 94305

This research was supported by grant number NIE-G-82-0027 from the National Institute of Education, Writing and Learning in the Secondary School, Judith Langer and Arthur Applebee co-principal investigators.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Judith A Langer

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

CS 210 098

Abstract

Inherent in such padagogical notions as "writing across the curriculum" and "writing to learn" is the assumption that the act of writing leads to an organization or reformulation of knowledge that supports topical learning. However, little research has directly focused on the effects of writing on subject learning. This paper reports two studies examining this issue.

In study one, 322 ninth and eleventh grade students read four passages from high school social studies and science texts and engaged in six writing-to-study conditions: reading only, reading plus supplementary reading, notetaking, notetaking plus supplementary reading, answering comprehension questions, and analytic writing. Learning was measured in three ways: passage specific knowledge probes, essay writing, and a multiple choise comprehension test. The essay writers scored consistently lower on the immediate topic knowledge posttest than those in the other conditions. However, the groups showing the largest immediate gains also showed the largest falling off at the four-week posttest. This led to the question of whether certain writing conditions focus the writer's attention on narrower but more lasting bands of information. Further, the essay criterion showed task differences at four weeks, reflecting superior performance in the three writing conditions compared with those in the read only conditions.

Study two focused on the relationship between what writers do during different writing tasks and what is remembered later. One hundred and one ninth and eleventh graders read two of the passages used in the first study, and engaged in four writing-to-study tasks: read and study, answering comprehension questions, summary writing, and analytic writing. Two outcome measures were used: topic knowledge and a general writing recall task. Findings indicate that the writing conditions led to greater recall of content than the non-writing condition, and that the more the content was manipulated during writing, the better it was recalled. Further, the effects of writing on learning were limited to the particular information written about.

Together, both studies indicate that writing tasks differ in the amount and kind of topic manipulation they invoke. Tasks such as question answering and notetaking involve a more superficial manipulation of more content and lead to more extensive but more short lived learning, while the analytic writing tasks involve greater depth of processing and lead to longer term learning of a smaller band of information.

Writing to Study and Learn

In recent years, increasing focus has been placed on the teaching of higher level reasoning and literacy skills in subject classrooms (e.g., Boyer, 1983; Commission on Excellence, 1983; NAEP, 1981, 1985). In particular, "writing to learn" and "writing across the curriculum," pedagogical notions growing from the belief that writing in some fundamental way leads to a reformulation and reconceptualization of knowledge, have become a part of the educational parlance of the 1980s (Langer, 1984a, 1986b). Despite such trends, at the present time there is insufficient evidence to assume that writing will bring about a generalized benefit to learning; the research is far from conclusive. Relatively few studies have looked at the effects of writing-to-learn-- when people learn from writing, what different kinds of learning result from engagement in different kinds of writing experiences, or how writing can be used to help students understand and remember the material they read about.

Background

Although no systematic research programs have looked directly at the relationships between various writing activities and subject matter learning, there is a tradition of related work that looks at adjunct questions (see Anderson & Biddle 1975 for a comprehensive review); and study behaviors (see Anderson & Armbruster, 1984 for a comprehensive review). Together, these bodies of work (e.g., Michael & Maccoby 1961; di Vesta & Gray

1972; Fisher & Harris, 1973; Schultz & di Vesta, 1972) suggest that engagement in a writing task after reading leads to better recall than when no writing takes place. In addition, studies looking at the differing amounts of cognitive manipulation required by various study tasks (e.g., Barnett, di Vesta, & Rogozinski, 1981; di Vesta, Schultz, & Danger, 1972; Frase 1970, 1972; Shallert, 1976; Schwartz, 1980, Watts & Anderson (1971), indicate that activities requiring more extensive cognitive manipulation of the material lead to greater recall than do those activities invoking less manipulation of ideas. Further, the advantages to learning and recall is not generalized, but seems to be related to the ways in which the material is cognitively manipulated during studying (Rothkopf, 1966, 1972; Bretzing & Kulhavy, 1979; Glover, 1981); depth of processing (Craik & Lockhart 1972) makes a difference.

Almost no studies have looked directly at the effects of writing on content learning. Newell (1985) compared the effects of notetaking, short answer questions, and essay writing on passage recall and posttest knowledge, and found significantly higher posttest knowledge in the essay writing condition, but no significant differences on his other measures. His protocol analyses using an adaptation of Flower and Hayes' (1980) procedure did, however, suggest differences in cognitive patterns across tasks, and these may reflect differences in depth of processing. Scardamalia and Bereiter (1981) do not study writing and learning relationships per se, but their work does suggest that thinking and writing about a topic can be improved by procedural facilitation activities which have a positive affect

on both the writing process and the completed paper.

In short, the existence of relationships between writing and learning have been only tangentially studied. Before large-scale changes are recommended for school practice, a body of research is needed to learn whether writing activities contribute to topic learning, or to the development of higher-level reasoning skills. And if so, how. These concerns led to the two studies reported here, focusing directly on the ways in which different kinds of writing-after-reading activities affect learning of their course material.

Study One

Study One was undertaken 1) to document the effects of writing versus not-writing (e.g., read and study or extra reading), and 2) to explore the effects of writing tasks that require reformulation of new information versus simpler ones that focus on review. For reformulation, tasks requiring analytic writing were developed; for review, two typical approaches, notetaking and answering comprehension questions, were selected.

Participants

A total of 332 students from six ninth grade and six eleventh grade classes in a middle class San Francisco Bay Area high school participated in this study. The students represented the full spectrum of abilities at each grade level, except that English as a second language classes and classes for the educationally mentally handicapped were excluded from the sample. The study was conducted late in the school year when absences

were running slightly above normal; of the 332 students in the participating classes, 297 were present at both testing sessions and completed the full set of measures. This included 165 boys and 132 girls.

Passage Selection

In developing the study tasks, four passages were selected from high school social studies texts. These dealt with: economic expansion after the Civil War; the great depression; political and economic developments in Russia after World War II; and the influence of science on life in the 20th century. Though drawn from longer units, all four were self-contained and able to stand alone. Each passage was paired with an additional passage that dealt with the same topic from a slightly different perspective. (See appendix for synopses of the eight passages and their characteristics.)

Study Conditions

Five different study tasks were designed for each passage: normal studying, supplementary reading, notetaking, comprehension questions, and analytic writing.

Normal studying. Students in the normal studying condition were asked simply, "Study the way you normally do to remember the information in the following passage." This condition allowed examination of how students would approach the task when allowed to choose their own methods.

Supplementary reading. For students in the supplementary reading condition, the target reading passage was followed

immediately by a passage on a related topic. The instructions paralleled those in the normal studying condition: "Study the way you normally do to remember the information in the following passages."

Notetaking. Students in the notetaking condition were asked, "Take notes to help you learn the information in the following passage." This is a review activity that relies on the students to concentrate on the most relevant material.

Comprehension questions. For the comprehension question condition, a series of short answer questions were designed similar to those students encounter in workbook study guides and teacher-made dittoes. Review activities of this sort focus the students' attention on specific aspects of the passages. Twenty questions were devised for each of the four passages, divided equally among textually explicit and textually implicit. Sample items about Economic Expansion follow:

> Please answer the following questions as you would answer questions for a homework assignment.
>
> Economic Expansion
>
> 1. What were the major manufacturing industries in the United States at the turn of the century?
> 2. By 1919, what major industries had emerged?
> 3. From being the fourth largest industrial producer, the United States moved to being the first largest between the years _____ and _____.
> 4. What did profits on goods, bank loans, and foreign investments have in common?

Analytic writing. The analytic writing assignments asked students to reformulate and extend the material from the reading passages as they developed evidence to support a particular interpretation or point of view. For Economic Expansion, the topic was:

> Given what you learned from the passage, what do you feel were the two or three most important reasons for industrial growth in the late 19th and early 20th centuries? Explain the reasons for your choices.

Measures

Three instruments were designed to examine what students had learned in the process of reading and studying the passages.

Tasks

Knowledge Growth. A measure of passage-specific knowledge developed by Langer (1980, 1984b,c; Langer & Nicoloch, 1981) was used to measure the ways in which the students' topical knowledge changed as a result of having engaged in the particular study activity. Five key concept words or phrases from the top half of the content hierarchy (see Meyer, 1975, 1981) were selected for each of the four target passages. Students were asked to provide written free association responses to the five concepts, which were presented one at a time. An unrelated concept (dog) was used as a practice item before the five words were administered. Practice exercises were given orally, and students were paced through the free-association task one concept at a time. Sufficient blank space was left between each concept to permit

students to provide as many associations as they could for each concept.

Passage Comprehension. A 20-item multiple-choice test was constructed for each passage, to measure overall comprehension. Eight items required a simple report of information from the passage, eight required the student to construct relationships among items of information in the passage, and four required drawing generalizations that extended beyond the passage. Items for each test were developed through a cycle of pilot testing that included interviews exploring participants' reasons for their answers, in order to insure that items and distractors were functioning as intended. Sample items from Economic Expansion follow:

Report of information in the passage:

1. How did the economy in the United States compare with the economy of other manufacturing nations by 1894?

a) The U.S. was in fourth place.

b) The U.S. was just beginning to catch up to France and Great Britain.

*c) The U.S. was in first place.

d) It was too early to measure the place of the U.S.

Analysis of relationships in the passage:

All of the following contributed to the growth of big business in the late 19th century except:

a) immigration.

b) increased demand for goods starting with the Civil War.

*c) government control of business activity.

d) the growing railroad system.

Generalization beyond the passage:

> Based on the reading you did, if you were the ruler of a developing nation, which of the following conditions would you try to foster to produce economic expansion?
>
> a) foreign investment.
>
> b) easy access to natural resources.
>
> c) closer regulation of business activity.
>
> *d) both (a) and (b).

The 20 items for each passage were randomly ordered, with the three types of questions interspersed.

Application of New Information

The final measure was an extended essay that required students to orchestrate what they had learned in a coherent argument based on the information from the original reading. Though requesting the same kind of writing as the analytic writing study condition, the format of the prompt and the specific topic differed in each case. For Economic Expansion, the instructions read:

> Write an essay based on what you learned from the reading on economic expansion. Use the title, "Causes and Effects of Industrial Growth at the Turn of the Century." Be certain to support the points you make.

Scoring

The various responses from each student were given an identifying code, separated, and randomly ordered so that coders would not know time (pre or post) or study task for the responses they were scoring.

Topic-Knowledge Measures. The measures of passage-specific knowledge were scored by rubrics developed by Langer (1980; 1984 b,c; Langer & Nicholich, 1981). For each concept in the knowledge measure, each free association was scored as indicating 1) peripheral knowledge of the concept, 2) concrete understanding (e.g., examples, attributes, defining characteristics), or 3) abstract understanding (e.g., superordinate concepts, definitions). Two raters scored each set of responses independently. Ratings reflecting levels 2 or 3 were then summed across concepts and raters to derive a total score for each passage. Interrater reliability for the total score (estimated by the Spearman-Brown formula) was .875. The test/retest correlation after 4 weeks and an intervening treatment period was .712.

Length. Students' responses during the study condition as well as their posttest essays were scored for number of words.

Essay Quality. Posttest essays were scored holistically for overall quality, using rubrics that focused on the use of evidence to support conclusions or positions based on the passages read. Two raters independently rank-ordered the 297 essays from 1 (best) to 297 (worst), scoring the essays from the four passages on a single scale. For the analyses reported here, tables of the normal distribution were used to convert each rater's scores to a normally-distributed scale ranging from 22 (best) to 1 (worst). Scores for the two raters were then summed to yield an essay quality score with a sample mean of 23.2 and

standard deviation of 7.5. Interrater reliability for the total score (estimated using the Spearman-Brown formula) was .94.

Comprehension

The multiple choice items were scored right or wrong, and summed to give a total correct (out of 20) for each passage.

Procedures

Separate but overlapping sets of 3 passages were used at each grade level (ninth and eleventh). The Great Depression was used only with eleventh graders; 20th Century Science only at grade 9. At each grade level, two classes were assigned at random to each passage. Study packets were assembled so that students within classes were randomly assigned to one of the 5 study conditions.

During the first day of the study, students first completed the passage-specific knowledge measure, followed by a packet containing general directions, the reading passage or passages, and directions for the study task. Ten minutes before the end of class, the study packets were collected and the passage specific knowledge measure was readministered. Students had 7 minutes for each administration of the knowledge measure, and the remainder of the 55-minute class period to read the passage or passages and to complete the study task.

Exactly four weeks later, all classes completed the 3 measures of learning. The passage specific knowledge measure was given first, followed by the essay test focusing on comprehension of relationships within the original passage. The multiple-

choice comprehension tests were administered last, so that the questions and multiple-choice answers would not provide students with additional information to draw upon in completing the other measures. Again, all measures were completed within a single class period.

Results and Discussion: Study 1

Responses to the Study Tasks

The first analysis examined how students had approached the normal studying and supplementary reading conditions. In both cases, two approaches were found: 36 percent of the students took notes, while the remainder spent their time rereading the material without writing anything down. (The proportion of notetakers was virtually identical in the normal studying and the supplementary reading conditions. Preliminary analyses of the data indicated that initial ability levels of students adopting the two approaches were comparable, as reflected in scores on the topic-specific knowledge measure.) Further analyses indicated that posttest performance of the students who had elected on their own to take notes was comparable to the performance of students who had been assigned to the notetaking condition. Thus for the remainder of the analyses of the effect of students' study behavior on their learning from the passages, treatment groups were defined to reflect the way the students had responded to the prompt. This led to the definition of six study conditions:

Reading only

Reading plus supplementary reading

Notetaking

Notetaking including supplementary reading

Comprehension questions

Analytic writing.

Table 1 summarizes the mean number of words written during the study task for students in each of these conditions. In general, the comprehension questions led to the most writing while studying, and the essay task to the least. Notetaking fell in between, with the addition of extra reading to the notetaking task depressing the amount of writing somewhat further. (The mean number of words for students in the notetaking condition changed only trivially as a result of the reclassification, from 120.2 in the original classification to 117.5 in the new grouping.)

Insert Table 1 about here

The pretest measure of passage specific knowledge provides a test of the comparability of the six groups, and a further check against any bias introduced in the definition of the six treatment groups. Variations with task were minor (Table 1). There were, however, very strong passage and grade level effects reflecting differences in students' prior knowledge of the material being introduced (Table 2). Students knew considerably more about the concepts drawn from the 20th Century Science and Great Depression passages than they did about those from Postwar Russia or Economic Expansion; as would be expected, eleventh graders also knew considerably more than ninth graders when they were assessed on comparable topics.

Insert Table 2 about here

Effects of Study Tasks on Learning

In examining task effects, we will look first at the study conditions that included the same original passage material, returning in a separate analysis to consider the effects of providing supplementary reading in the notetaking and reading-only conditions.

Results from the three sets of outcome measures are summarized in Tables 3, 4, and 5. Because the ninth and eleventh grade samples were based on overlapping but different passage sets, there are three sets of results for each measure, one for the three passages at grade 9, one for the three at grade 11, and one combining across grades for the two common passages.

Results for the multiple-choice comprehension test (Table 3) and for the measure of passage-specific knowledge (Table 4) show similar significant effects for grade level and passage, but little influence of task at the immediate or four-week posttest. The results from the topic-knowledge measure at the immediate posttest show the essay writing group scoring consistently lower than the other conditions. This may indicate that the analytic essay focused students' attention on a narrower range of information in the passage, while the notetaking and comprehension questions led them to distribute attention more evenly over information in the passage as a whole. On the other hand, groups that showed the largest immediate gains also showed the largest falling off between the immediate and 4-week posttests.

Insert Tables 3 and 4 about here

The third measure from the four-week posttest was the quality of the essay that required students to apply what they remembered from the passage in support of an argument or interpretation. For this measure there were consistent task differences, reflecting the superior performance of students in the three writing conditions compared with those in the read-only condition (Table 5). Among the writing conditions, students from the notetaking group did less well than did those from the essay or comprehension question groups, though the difference was significant only for the analysis across grades based on the two common passages.

Insert Table 5 about here

It is interesting that the essay scores showed task differences at four weeks even though the other measures did not. The essay task differed in three important ways from the other two: it provided fewer test-determined cues to recall, required orchestration of relationships among the information that was remembered, and could be completed successfully using a narrower (but perhaps better remembered) selection of information from the original passage.

Effect of Amount Written on Posttest Performance

We can also ask whether writing <u>more</u> is related to better posttest performance, whatever particular writing task a student may have been assigned. In the present study, that involved looking at the relationship between the amount written during the study task and posttest performance, after accounting for all of

the other factors and covariates in the model (passage, task, grade level, and pretest passage-specific knowledge).

Table 6 presents the relevant pooled within-cell correlations. (Students in the read-only condition are omitted from these analyses, since there is no variation in amount written within that group.) These relationships are consistently positive and significant, indicating that in addition to any effects due specifically to the individual tasks, those who do more writing while completing a task tend to do better on posttest measures of performance. (It is important to remember that the correlations have been corrected for pretest performance-- they are not simply the result of good students doing better in everything.)

Insert Table 6 about here

Supplementary Reading

In addition to the students included in the above analyses, two supplementary reading conditions were included in the overall study: one that received extra reading and studied without taking notes, and a second that received the same extra reading but also took notes on what they read. These two groups can be compared with the reading-only and notetaking groups already discussed, to assess the effects of the supplementary reading.

Results for overall quality of the 4-week essay, summarized in Table 7, indicate a significant interaction among grade level, study task, and extra reading. At grade 9, there were no significant differences among the various conditions, though those who took notes did slightly better than those who did not,

and those who received supplementary reading material did slightly better than those who received only the original passage. At grade 11, however, notetaking and supplementary reading seemed to compete with one another for attention: either condition led to improvement over the read-only condition, but students who were given supplementary reading and took notes seem to have had too much to do-- and ended up performing most poorly of all.

Insert Table 7 about here

Results from this study are interesting but complicated. Rather than general effects, task differences emerge only on the more complex and time consuming of the outcome measures, the essay requiring students to use what they had learned to mount an argument of their own. The other measures, which may have tapped a broader spectrum of remembered information, show few differences among tasks.

The superior performance of the three writing groups on the 4-week essay is encouraging, given our general hypotheses about the relationships among writing and reasoning. On the other hand, the effects are relatively small, and the differences among the three writing conditions (notes, comprehension questions, and extended writing) are difficult to untangle. Results from the topic-knowledge measure suggest that the essay task may have focused students' attention on a narrower band of information, though by four weeks any advantage to the other conditions seems to have disappeared. The evidence from the within-cell correlation measures also suggests that there may be a

relationship between what was written about and what was remembered; at the least, writing more seemed to be related to how much was remembered later.

A second study was designed to pursue some of the major questions raised by the first. With more focused measures of outcomes, would differences be discernable between various types of writing tasks? Could behavior during the study task be more directly traceable to posttest performance?

Study Two

The second study focused on the relationship between what students did during the study task and what they remembered later. It was concerned with both the particular information focused on during the study task, and the type of focus (as determined by the demands of varying types of writing tasks). Were students more likely to remember information specifically drawn upon during a writing task than they were to remember information included in the passage but not in their writing? Would some tasks lead to more lasting or stronger effects than other tasks?

To do this, a recall task was chosen that would permit systematic examination of learning of the full spectrum of information in the original passages, and the number of passages and students was reduced in order to examine each protocol in more detail. The time was reduced between the study task and the posttest, in order to detect task differences that might not be evident a month after a single intervention. It was assumed that such differences might be of practical importance under ordinary

classroom conditions, in which writing tasks are often longer-lasting, better-motivated, and more cumulative than those contrived for the experimental situation. The tasks examined included a read and study condition (with no writing), comprehension questions, summary writing, and the writing of an an analytic essay.

Participants

The 101 students who participated in this study were 9th and 11th grade students attending a high school similar to the one in the first study. Mean student achievement levels were average on a variety of regularly administered, nationally normed achievement batteries.

Passages and Tasks

In developing the study tasks, two passages were selected from those used in the previous study: Postwar Russia and Economic Expansion. (Synopses of the passages and their characteristics are included in the appendix.)

Four different study tasks were designed for each passage: read and study, comprehension questions, summary writing, and analytic writing.

Read and study. For the read and study condition, students were asked simply, "Study the reading passage. Do not do any writing."

Comprehension questions. The comprehension question condition was identical to that in Study 1. Twenty questions were devised for each of the passages, divided equally among textually explicit and textually implicit.

Summary writing. The summary writing task was designed to prompt review of the new material in an extended, cohesive text. Students received the following assignment: "In your own words, write a 200-250 word summary of the passage you just read."

Analytic writing. The analytic writing assignments were designed to require the students to reformulate and extend the material from the reading passages as they developed evidence to support a particular interpretation or point of view. Topics were identical to those used in Study 1.

Measures

Two outcome tasks were used, each yielding two or more measures; the tasks and scoring procedures follow:

Topic Knowledge. Langer's (1980, 1984b,c) measure of passage-specific knowledge was again used to measure the ways in which the students' topical knowledge changed as a result of having engaged in the particular study activity. Three key concept words or phrases from the top half of the content hierarchy (see Meyer, 1975) were selected for each of the two passages. The six words were intermixed, and administered as a single set of concepts. Students were asked to provide written free associations to each of the six concepts. The measure was scored to reflect the amount of passage-relevant information reflected in the free associations. Two scores were derived for each student, one for the target passage and one for the other passage in the study (a control condition).

Recall tasks. For the recall tasks, students were asked,

"Please write down everything you can remember about the passage that you read." The recall protocols were scored for number of words, number of T-units (Hunt, 1965), and preservation of the original gist of the passage. (Though cast somewhat differently, the measure of gist is on overall measure of quality, roughly comparable to the holistic essay score in the previous study.) Raters used a 4 point scale, from 1 (no reflection of original gist) to 4 (very good preservation of original gist). Interrater agreement for independent ratings of a subset of 30 recalls was .87.

In order to relate the information included in the recall tasks to the original passages, each passage was first analyzed for hierarchical content structure using an adaptation of Meyer's (1975, 1981) prose analysis system. For this analysis, each passage was divided into sequentially numbered T-units, which were then analyzed in terms of their rhetorical relationships to other information in the passage. For example, content units appearing at level 2 of the content hierarchy are very central to the major theme of the passage, while those at levels 4 and 5 are explanations and elaborations of the higher level ideas. Two project team members analyzed each passage; differences were resolved by a third analyst. The resulting tree diagrams for the two passages are included in appendix 1. The first passage, Postwar Russia, contained 81 content units; the second passage, Economic Expansion, contained 50 content units.

The tree diagrams were used to examine students' responses during the study and recall tasks, content unit by content unit.

A particular content unit was counted as "included" if any of the central ideas from the original T-unit appeared, at any place during the study or recall task. Interrater agreement for the inclusion of individual T-units was .95 for two raters who separately scored a subsample of 20 of the recalls. From these analyses, we defined content units manipulated as content units from the passage that also appeared at any point in the written material from the three study tasks that required writing: comprehension questions, summary writing, and analysis writing. Content Units Recalled were defined as any content units from the original passage included in the student's written recall. These were further subdivided to reflect level of the content unit in the original passage hierarchy, and to reflect whether the content unit had been manipulated during the study task.

Procedures

During the class period when they regularly met with the participating teachers, the students were asked to complete the measure of passage-specific knowledge, and then to read one of the two social studies passages (assigned randomly within each class). After reading the passages, the students engaged in one of the study conditions: rereading and studying, answering comprehension questions, summarizing, or writing a paper that asked them to defend a particular interpretation based on the text. The passages were prepared with instructions for the study conditions attached, and were randomly distributed through the class. The passage-specific knowledge measure was repeated during class the following day. Five days after the initial

study task, students completed the passage-specific knowledge measure for a third time, followed by the recall task.

Results and Discussion: Study 2

Task Characteristics

To understand the effects of the various tasks on student learning, we need first to examine the nature of the tasks themselves. Three of the tasks (comprehension questions, summary writing, and analysis writing) asked for written responses. The general characteristics of these responses are summarized in Table 8.

Insert Table 8 about here

In terms of number of words, the students did the most writing when asked to summarize the passage, and the least when asked to write analytically about what they had read. Because the comprehension questions could often be answered somewhat telegraphically, relying upon (rather than repeating) words in the question stem, the word count may be somewhat misleading as a measure of the extent of engagement with particular content. If we look instead at the proportion of content units that were mentioned in the course of the study task, the picture looks somewhat different. Responses to the comprehension questions touched on a higher proportion of content units (25 percent) than did responses to either of the extended writing tasks. As in total number of words, analysis writing involved the smallest proportion of content from the original passage (15 percent).

From these data we might conclude that the comprehension questions led the students through the most thorough review of

the material they were studying, and that the analytic writing condition, in contrast, led them to focus most narrowly on a subset of that information, in the process of reformulating and extending it. The analytic writing task also led to more complex syntax, as reflected in the measure of words per T-unit. This is consistent with the hypothesis that analytic writing leads to more complex interrelating of ideas in the course of reformulating the material in order to develop and defend a thesis or argument.

The Influence of the Study Tasks on Recall

The study included three sets of measures of what students remembered about what they read: recall of content units, topic specific knowledge, and recall of gist.

Content Units Recalled

Table 9 summarizes the patterns of recall of content units on the day following initial reading of the passage. If the tasks are ordered according to their predicted effectiveness as aids to learning (Read and study < Comprehension questions < Summary writing < Analytic writing), there is a significant linear effect for task ($p < .03$). The tasks involving writing led to better recall than did the read and study condition, and the extended writing tasks (summary and analysis) led to better recall than the more restricted writing task (comprehension questions). The proportion of content recalled for all four tasks was relatively low, however, ranging from a high of 12 percent for students in the analytic writing condition to a low of 8 percent for those in the read and study condition.

Insert Table 9 about here

Was important information from the passage more likely to be recalled than less important information? To examine this, let us look first at recall in the top third, middle third, and bottom third of the content hierarchy in the original passage (Table 8.2). Overall, there was a tendency for content higher in the passage structure to be more likely to be recalled, but the pattern was not particularly strong (12.6 percent for content from the top third compared with 8.8 percent for content from the bottom third).

Of much more importance than level in the content hierarchy was whether or not a particular content unit had appeared in the writing completed as part of the original study task. Here, the extent to which a student had focused on a particular content unit emerged as crucial in later recall. On average, students recalled 40.2 percent of the content units they had directly manipulated during the study task, compared with only 5.3 percent of the content units that they had not directly manipulated (Table 9).

Further, the type of manipulation (as reflected in the nature of the study task) also had a significant effect, again in the predicted direction. Students who completed comprehension questions recalled 32 percent of the content units that they included in their study task; students who summarized the passage recalled 39 percent; and students who completed an analytic writing task recalled fully half percent of the material they had used. Recall of material not manipulated as part of

the study task showed a similar trend ($p < .06$), though even in the analytic writing condition it averaged only 7 percent of the material.

These patterns of recall were remarkably stable even at the five day retention test (Table 10). Overall recall dropped from 10.8 percent at day 2 to 8.4 percent at day 5, with the two extended writing conditions continuing to do better than comprehension questions or read and study. The strongest effects continued to be associated with whether or not particular content units had been included in the study task: recall of content manipulated remained at 33.2 percent, compared with 4.3 percent for content that had not been manipulated. Similarly, the types of manipulation involved in analytic writing led to the best retention (44.4 percent), summary writing next (34.5 percent), and comprehension questions least (25 percent). By day 5, however, effects of task on recall of content units that had not been included in the study task had disappeared.

Insert Table 10 about here

Capturing the Gist

It is possible to remember a goodly number of isolated facts from a passage without necessarily being able to relate those facts to one another in a systematic way. To assess this, each recall was also rated on a four-point scale reflecting the extent to which it captured the gist, or overall sense, of the original text. Table 11 reports mean scores for recall of gist, as well as the percent of recalls rated as "good" or "very good" at capturing the gist (3 or 4 on the scale).

Insert Table 11 about here

At day 2, students were more successful in recalling the gist of the passage about Postwar Russia (43 percent rated good) than they were at the passage on Economic Expansion (31 percent)-- even though Postwar Russia was a longer passage with a higher readability level. There was a significant task effect, with all three tasks that required at least some writing surpassing the read and study condition, and with students from the analytic writing condition receiving considerably more "good" ratings for gist (60 percent) than those who had completed comprehension questions (32 percent) or summary writing (36 percent). By day 5 the effects were much weaker, though the two extended writing tasks continued to receive better ratings than either of the other two conditions.

Topic Knowledge

The third measure of the effects of the three study tasks was based on Langer's (1980, 1984b,c) measure of topic-specific knowledge. This measure can be used whether or not the students have read a particular passage; it was completed by all students three times (before reading, at day 2, and at day 5). At each administration, each student completed the measure for the assigned passage as well as for the alternate (unread) passage. In analysing the data, the two passages were treated as separate replications; in each case, the students who had read the other passage were analyzed as an additional control condition, of unrelated reading. (That is, students who read Postwar Russia

also completed the Economic Expansion knowledge measure, and their responses to this measure over time were analyzed as an "unrelated reading condition" in analyzing results for Postwar Russia; conversely, in the analysis of Economic Expansion, responses of students assigned to Postwar Russia formed the unrelated reading group.) Simple gain scores were computed in order to examine task effects at day 2 (day 2 score- pretest score) and day 5 (day 5 score - day 2 score).

Results for this measure, summarized in Table 12, reflect an interaction between passage and task. For passage 1 (Postwar Russia), simply reading the passage led to a sharp increase in knowledge (gains of 0 for students in the unrelated reading condition compared to gains of 3.1 for those in the read and study condition). The summary writing task led to the largest gains on this measure (4.3), and analytic writing fared relatively poorly (2.3). On passage 2 (Economic Expansion), simply reading the passage had no effect on knowledge, and scores for the 3 conditions that involved some writing were patterned as predicted, with the largest gains for the analytic writing condition.

Insert Table 12 about here

The results for gist, discussed above, may help us make sense of this pattern. At Day 2, gist scores for passage 1 (Postwar Russia) were significantly higher than for passage 2 (Economic Expansion); students seem to have had a relatively easy time making sense of the account of recent Soviet history, and in turn quickly developed a cluster of passage-relevant information.

The passage on economic factors in the post-Civil War era, on the other hand, was more difficult to make sense of-- the focused attention provided by the three tasks that involved writing seems to have been more necessary in helping the students interrelate the information in the way reflected in the scores for gist, as well as in the background knowledge measure.

Results for day 5 (also summarized in Table 12) reflect decreases in passage-specific knowledge since day 2. These decreases are relatively constant across tasks, except for the results for summary writing. For both passages, students in the summary writing condition show a much sharper decrease in knowledge scores than do those in any of the other conditions.

General Discussion

Looking across the series of studies, the following conclusions can be drawn about the role of writing in learning:

1. The more that content is manipulated, the more likely it will be remembered and understood. In general, any kind of written response leads to better performance than does reading without writing. Tasks that provoke more writing lead in general to more learning than do tasks that lead to less writing. And even within particular tasks, students who write at greater length tend to perform better than students who write less, even after allowing for a general tendency for better students to do better at everything.

2. The effects of writing tasks are greatest for the particular information focused upon during the writing. Results suggest that the effects of writing on learning are

highly specific, and limited to information and ideas that are reexpressed in the process of writing about them. While it might be hoped that the process of writing about text material would lead to a more careful review of the whole text, forcing a review and reconceptualization of all of its parts in the process of selecting what to write about, there is nothing in the results to suggest that this in fact occurs. Rather than a generalized effect of writing on learning, there is a limited-- and in some cases perhaps a limiting-- one. Put another way, these results suggest that the particular writing task chosen may matter a great deal, depending upon a teacher's objectives.

3. Writing tasks differ in the breadth of information drawn upon, and in the depth of processing of that information that they invoke. Thus notetaking and summarizing tasks, which focus attention across a text as a whole, have quite generalized effects, though they lead to relatively superficial manipulation of the material being reviewed. They may be the tasks of choice when the purpose is to review a general body of information. Analytic writing tasks, on the other hand, focus the writer more narrowly on a specific body of information, and in particular upon the relationships that give structure and coherence to that information. In the context of learning from text, such tasks seem to lead to better retention of a smaller body of information. They will be the tasks of choice when the emphasis is on concepts and relationships, in contexts where these relationships are more important than memory for a larger body of facts.

4. If content is familiar and relationships well-understood, writing may have no major effect at all. In these cases, simply reading the passage without any other attendant activity may be all that is needed to insure comprehension and to remind readers of what they already know.

The results, as expected, are complex. They suggest that "writing across the curriculum" is perhaps too simplistic a concept, but the results provide good support for the underlying premise that writing tasks have a significant role to play in areas of academic study and learning.

Appendix

Characteristics of the Reading Passages

Short Title	Number of Words	Textbook Level	Readability Level*
Economic Expansion			
Main passage	766	Grade 11	Grade 10
Supplementary	1050	Grade 11	Grade 7
Postwar Russia			
Main passage	1123	Grade 9	Grade 12
Supplementary	785	Grade 9	College
Great Depression			
Main passage	1721	Grade 11	College
Supplementary	1478	Grade 11	Grade 8
20th Century Science			
Main passage	837	Grade 11	Grade 12
Supplementary	686	Grade 9	College

*Based on Fry formula

Synopses of the Reading Passages

Economic Expansion

This passage traces industrial growth in the United States from the Civil War until the early 1900s, by which point the U.S. had emerged as the leading industrial nation. Several factors of growth are discussed, including natural resources, the growth of railroads, a growing labor force, available capital, new technology, and favorable government attitudes. The passage is loosely organized, with many specific but undeveloped examples to support its main points. (Source: G. M. Linden, E. A. Wassenich, D. C. Brink, and W.J. Jones, Jr., History of Our American Republic River Forest, IL: Laidlaw, 1979; pp. 431-432.)

The supplementary reading covers the same time period, but emphasizes regional differences in economic growth. Although touching on the same points as the main reading, it develops the growth of rail transportation and the importance of government support for industry more fully. (Source: G. M. Linden, E. A. Wassenich, D. C. Brink, and W.J. Jones, Jr., History of Our American Republic River Forest, IL: Laidlaw, 1979; pp. 279-282.)

Postwar Russia

This passage traces the political and economic history of the Soviet Union from the end of World War II through the beginning of Krushchev's rule. Topics include Stalin's 5 Year Plans to meet the problems of postwar reconstruction; the imposition of Communist rule in Eastern Europe; Tito's independence in Yugoslavia; and Kruschev's attempts to raise the standard of living as well as to develop heavy industry and military weaponry. (Source: T. W. Wallbank and A. Schrier, Living World History. NY: Scott, Foresman, 1974; pp. 687-689.)

The supplementary reading focuses on the development of satellite countries in Eastern Europe, and the birth of the "iron curtain." Developments in Yugoslavia are treated in greater detail, as is the power struggle after Stalin's death. (Source: D. Roselle, A World History. NY: Ginn, 1963; pp 674-677.)

The Great Depression

After describing the prosperity of the 1920s, this passage moves to the stock market crash in 1929, and the spread of depression in the years that followed. A variety of conflicting explanations of the Great Depression are mentioned, with no attempt to resolve the disagreement. The passage ends with a chronology of Hoover's responses during the early years of depression, making the point that the President had accepted, for the first time, the idea that the federal government must assume some responsibility when the economy suffers. (Source: L. P. Todd and M. Curti, Rise of the American Nation, Heritage Edition. NY:

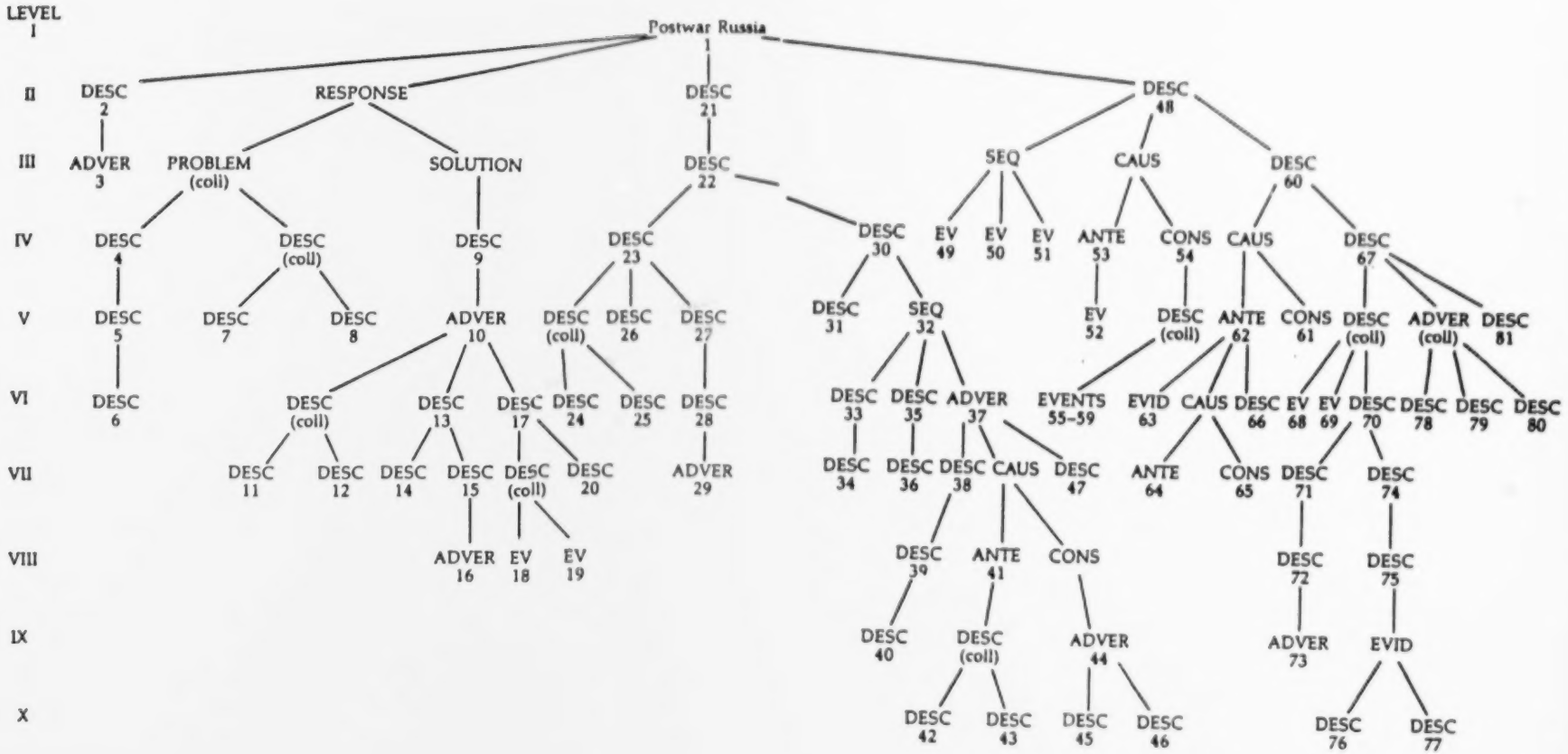
Harcourt Brace Jovanovich, 1982; pp. 555-558.)

The supplementary reading covers the same period and topics, though explains the depression primarily in terms of overproduction. Hoover's programs are treated in somewhat more detail, with more attention to the political philosophy guiding the choices Hoover made. (Source: G. M. Linden, E. A. Wassenich, D. C. Brink, and W.J. Jones, Jr., History of Our American Republic. River Forest, IL: Laidlaw, 1979; pp. 493-496.)

20th Century Science

This passage details the variety of effects that modern science has had on contemporary life. Topics include new comforts and conveniences, the development of assembly line production, medical advances, industrialization, and the extent to which scientists and scientific advances have become front page news. The passage is structured as a variety of elaborations on the central theme of scientific progress, with little connection between individual sections. (Source: C.J.H. Hayes and M. Faissler, Modern Times, Macmillan, 1965; pp. 507-510.)

The supplementary reading touches on an almost identical set of themes though in a different order and with new examples. Like the main passage, it is essentially a series of separate elaborations on the central topic. (Source: T.W. Wallbank and A. Schrier, Living World History. NY: Scott, Foresman, 1974; pp. 729-731.)



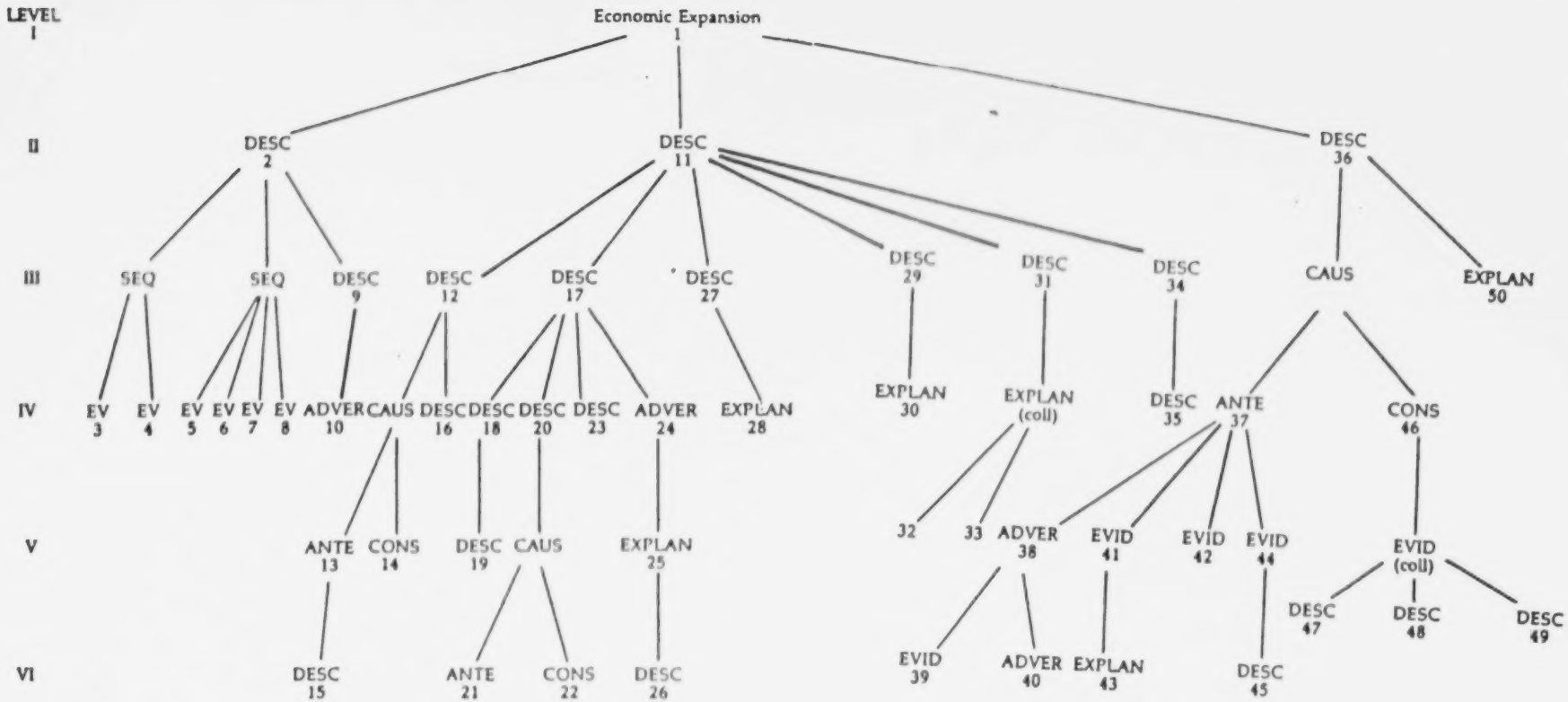
Tree diagram 1. Key content nodes in reading passage on postwar Russia. See Fig. 1, for key content and key to abbreviations.

1. Postwar Russia
2. had army, territory
3. suffered destruction
4. reconstruction
5. suffered most
6. millions killed, destroyed
7. critical tasks
8. consolidate Eastern Europe
9. relaxed control
10. Stalin restored CCP authority
11. Stalinist beliefs, practices
12. censorship
13. 5-year plans
14. rebuild, expand
15. industrial doubled
16. consumer goods scarce
17. controlled agriculture
18. mass collectivization
19. peasants supervised
20. incentive production 10% higher
21. communist revolutions in Eastern Europe
22. six countries
23. common characteristics
24. peasants
25. poor
26. upper classes no reform
27. discredited ruling groups
28. peasant parties
29. leaders intellectuals
30. Red Army
31. Soviet-style revolution
32. two stages
33. People's Democracy
34. Bulgaria, Romania, Poland 1946
35. Communist dictator
36. Bulgaria, Romania, Poland, Hungary, Czechoslovakia 1953
37. Yugoslavia exception
38. Tito without troops
39. Tito, resistance
40. Yugoslavs united
41. Stalin angry
42. expelled from Cominform
43. withdrew aid
44. Tito did not topple
45. turned to West
46. loosened rule
47. Yugoslavian communist independence
48. Stalin's death changes
49. Stalin
50. leadership struggle
51. Krushchev
52. speech
53. denounced Stalin
54. deStalinization
55. camps
56. police
57. writers
58. exchanges
59. tourists
60. Krushchev changes

Figure 1. Key content (by node number) and key to abbreviations for postwar Russia tree diagram.

61. shortages
62. rural migration
63. in cities
64. demanded production
65. demanded incentive
66. middle class
67. desires
68. TV, clothes
69. housing
70. total production
71. industry up, agriculture lagged
72. tried schemes
73. barely kept pace
74. emphasized military, industrial, space
75. impressive results
76. A-bomb, H-bomb
77. satellite, spaceman, landing
78. clothes
79. housing
80. highways
81. economy not all consumer

DESC = Description
ADVER = Adversative
SEQ = Sequence
CAUS = Causal
coll = collection
EV = Event
ANTE = Antecedent
CONS = Consequence



Tree diagram 2. Key content nodes in reading passage on economic expansion. See Fig. 2. for key content and key to abbreviations.

1. Economic Expansion
2. Industrial growth
3. After Civil War
4. Growth continued
5. fourth to third place
6. one-third of industrial production
7. France and Great Britain
8. 24 billion
9. Technology and immigration
10. other
11. Factors of growth
12. Several reasons
13. Started during Civil War
14. To meet demands
15. factories in north
16. 79% increase
17. Natural resources
18. coal
19. Over 30%
20. oil
21. Production grew
22. By 1914
23. other raw materials
24. little use
25. Thus, railroads
26. 260,000 miles
27. Labor helped
28. workers available
29. availability of money
30. from profits
31. improved technology
32. technology
33. federal policies
34. combination
35. GNP
36. Economy in early '20s
37. growth continued
38. Although
39. Panic of 1907
40. Early 1900s prosperous
41. GNP up 500% 1900–1920
42. amount manufactured up 32%
43. agriculture and service occupations
44. 100% growth in employment
45. 40 million full-time by 1920
46. Good conditions helped industry
47. meat, iron, steel
48. paper, chemicals, petroleum
49. automobile 4 billion
50. Thus, most industries

DESC = Description
ADVER = Adversative
SEQ = Sequence
CAUS = Causal
coll = collection
EV = Event
ANTE = Antecedent
CONS = Consequence
EXPLAN = Explanation

Figure 2. Key content (by node number) and key to abbreviations for economic expansion tree diagram.

References

Anderson, T.H. & Armbruster, B.B. (1984). Studying, in P.D. Pearson (Ed.) Handbook of research on reading.

Barnett, J., di Vesta, F.J., & Rogozinski, J.T. (1981). What is learned in note taking? Journal of Educational Psychology, 73 (2), 181-192.

Boyer, E.L. (1983). High school: A report on secondary education in America. NY: Harper & Row.

Bretzing, B.H., & Kulhavy, R.W. (1979). Notetaking and depth of processing. Contemporary Educational Psychology, 4, 145-153.

Bretzing, B.H., & Kulhavy, R.W. (1981). Note-taking and passage style. Journal of Educational Psychology, 73 (2), 242-2[illegible].

Commission on Excellence (1983). A nation at risk. Washington, DC: U.S. Government Printing Office.

Craik, F.I.M., & Lockhart, R.S. (1972). Levels of processing: A framework for memory research. Journal of Verbal Learning and Verbal Behavior, 11, 671-684.

di Vesta, F.J., & Gray, G.S. (1972). Listening and notetaking. Journal of Educational Psychology, 63, 8-14.

di Vesta, F.J., Schultz, C.B., & Dangel, T.R. (1973). Passage organization and imposed learning strategies in comprehension and recall of connected discourse. Memory & Cognition, 1 (4), 471-476.

Fisher, J.L. & Harris, J.R. (1973). Effects of notetaking and review on recall. Journal of Educational Psychology, 65, 321-325.

Flower, L.A. & Hayes, J.R. (1980a). The dynamics of composing: Making plans and juggling constraints. In L. W. Gregg and E.R. Steinberg (Eds.), Cognitive processes in writing, Hillsdale, NJ: Erlbaum.

Flower, L.A., & Hayes, J.R. (1980b). The cognition of discovery: Defining a rhetorical problem. College Composition and Communication, 31, 21-32.

Frase, L.T. (1970). Influence of sentence order and amount of higher level text processing upon reproductive and productive memory. American Educational Research Journal, 7 (3), 307-319.

Frase, L.T. (1972). Maintenance and control in the acquisition of knowledge from written material. In J.B. Carroll and R.O.

Freedle (eds.), Language comprehension and the acquisition of knowledge. NY: John Wiley & Sons.

Glover, J.A., Plake, B.S., Roberts, B., Zimmer, J.W., & Palmere, M. (1981). Distinctiveness of encoding: The effects of paraphrasing and drawing inferences on memory from prose. Journal of Educational Psychology, 73 (5), 736-744.

Hunt, K.W. (1965). Grammatical structures written at three grade levels. Champaign, IL: National Council of Teachers of English.

Langer, J.A. (1980). Relation between levels of prior knowledge and the organization of recall. In M. Kamil & A. Moe (eds.), Perspectives in reading research and instruction. Washington, DC: National Reading Conference, 28-33.

Langer, J. A. (1982). Facilitating text processing: The elaboration of prior knowledge. In J.A. Langer & M. T. Smith-Burke (Eds.), Reader meets author/Bridging the gap. Newark, DE: International Reading Association.

Langer, J.A. (1984a). Literacy instruction in American schools: Problems and perspectives. American Journal of Education, vol. 93, 107-132.

Langer, J.A. (1984b). The effects of available information on responses to school writing tasks. Research in the Teaching of English, 18, 27-44.

Langer, J.A. (1984c). Examining background knowledge and text comprehension. Reading Research Quarterly, 19, 4, 468-481.

Langer, J. A. (1986b). Reading, writing, and understanding: An analysis of the construction of meaning. Written Communication, 3, 2.

Langer, J.A. & Nicolich, M. (1981). Prior Knowledge and its effect on comprehension. Journal of Reading Behavior, 13, 4, 339-379.

Meyer, B.F. (1975). The organization of prose and its effects on memory. Amsterdam: Elsevier/North Holland

Meyer, B.F. (1981). Prose analysis: Procedures, purposes, and problems. Department of Educational Psychology, College of Education, Arizona State University.

Michael, D.N., & Maccoby, N. (1961). Factors influencing the effects of student participation on verbal learning from films. In A.A. Lumsdaine (Ed.), Student response in programmed instruction. Washington, DC: National Academy of Science.

National Assessment of Educational Progress. (1981). Reading, thinking, and writing: Results from the 1979-80 national assessment of reading and literature (Report No. 11-L-01). Denver, CO: Education Commission of the States.

National Assessment of Educational Progress. (1985). The Reading report card: Trends in four national assessments. Princeton, NJ: Educational Testing Service.

Newell, G. (1985). A case study/protocol analysis of writing to learn. Research in the Teaching of English, 18 (3).

Rothkopf, E.Z. (1966). Learning from written instructive materials: An exploration of the control of inspection behavior by testlike events. American Educational Research Journal, 3, 241-249.

Rothkopf, E.Z. (1972). Variable adjunct question schedules, interpersonal interaction, and incidental learning from written material. Journal of Educational Psychology, 63, 87-92.

Scardamalia, M., & Bereiter, C. (1981, October). Development of dialectical processes in composition. Paper presented at the Conference on the Nature and Consequences of Literacy, Ontario Institute for the Study of Education, Toronto.

Schallert, D.L. (1976). Improving memory for prose: The relationship between depth of processing and context, Journal of Verbal Learning and Verbal Behavior, 15, 621-32.

Schultz, C.B., & di Vesta, F.J. (1972). Effects of passage organization and note taking on the selection of clustering strategies and on recall of textual materials. Journal of Educational Psychology, 63, 244-252.

Schwartz, R.M. (1980). Levels of processing: The strategic demands of reading comprehension. Reading Research Quarterly. 15, 4, 433-450.

Watts, G. H., & Anderson, R. C. (1971). Effects of three types of learning from prose. Journal of Educational Psychology, 62, 387-394.

Table 1

Task Characteristics

		Essay	Comprehension Questions	Notes	Reading Only	Extra Notes	Extra Reading
Words written during task							
Grade 9	M	98.1	106.0	96.2	0.0	89.8	0.0
	SD	(53.0)	(60.1)	(46.7)		(28.4)	
Grade 11	M	123.0	95.2	134.7	0.0	80.1	0.0
	SD	(34.9)	(63.0)	(65.7)		(39.4)	
Pretest passage Knowledge							
Grade 9	M	12.2	10.3	14.8	10.7	13.1	10.5
	SD	(12.4)	(9.4)	(11.7)	(10.4)	(10.0)	(10.5)
Grade 11	M	13.3	9.0	14.6	12.8	14.8	11.6
	SD	(9.1)	(6.8)	(10.0)	(7.7)	(10.0)	(10.4)
Number of Students		61	54	84	40	20	38

Table 2

Pretest Passage Knowledge by Passage and Grade

	Grade 9		Grade 11	
	M	(SD)	M	(SD)
Passage				
20th Century Science	22.1	(10.0)	-	-
Postwar Russia	4.8	(5.6)	11.8	(10.1)
Economic Expansion	7.8	(5.5)	10.9	(6.5)
Great Depression	-	-	16.0	(9.2)
Number of students	145		152	

Table 3

Multiple-Choice Comprehension, Four Weeks

	Number of Passages	Within-Cell SD	Adjusted Means: Essay	Comprehension Questions	Notes	Reading Only
Grade 9	3	2.5	9.0	9.1	9.0	8.1
Grade 11	3	2.7	9.6	10.7	10.4	10.8
Pooled	2	2.7	9.4	10.1	9.9	9.7

Significant Effects (Task by Passage by Grade covaried on pretest passage knowledge)

Pooled analysis:
- Passage: $F(1;125) = 73.16$, $p < .001$
- Grade: $F(1;125) = 17.68$, $p < .001$

Grade 9 analysis:
- Task (Reading vs writing): $F(1;97) = 2.13$, $p < .147$
- Passage: $F(2;97) = 18.73$, $p < .001$

Grade 11 analysis:
- Task (Essay vs Questions): $F(1;92) = 1.98$, $p < .163$
- Passage: $F(2;92) = 28.28$, $p < .001$

Table 4

Gain in Passage-Specific Knowledge, Immediate and Four-Week

	Number of Passages	Within-Cell SD	Adjusted Means: Essay	Comprehension Questions	Notes	Reading Only
Immediate						
Grade 9	3	8.48	2.2	4.3	6.2	5.9
Grade 11	3	8.93	5.0	8.9	7.6	8.5
Pooled	2	8.49	6.3	6.5	8.8	9.0
Four-Week						
Grade 9	3	6.55	3.1	2.2	4.6	1.4
Grade 11	3	9.82	2.5	6.1	2.6	4.3
Pooled	2	7.69	3.5	3.7	4.5	4.4

Significant Multivariate Effects
(Task by Passage by Grade covaried on pretest passage knowledge)

Pooled analysis:
- Passage: $F(2;125) = 7.78$, $p < .001$
- Passage x Grade: $F(2;125) = 6.12$, $p < .003$

Grade 9 analysis:
- Task (Note vs other write): $F(2;93) = 1.64$, $p < .199$
- Passage: $F(4;186) = 5.40$, $p < .001$

Grade 11 analysis:
- Passage: $F(4;186) = 6.51$, $p < .001$

Table 5

Essay Quality, Four Weeks

	Number of Passages	Within-Cell SD	Adjusted Means: Essay	Comprehension Questions	Notes	Reading Only
Grade 9	3	6.12	23.1	23.1	21.6	20.3
Grade 11	3	7.35	25.4	27.4	25.2	22.4
Pooled	2	6.41	22.9	24.5	21.0	18.8

Significant Effects (Task by Passage by Grade covaried on pretest passage knowledge)

Pooled analysis:
- Task (Reading vs writing) $F(1;122) = 7.02$, $p < .009$
- Task (Notes vs other) $F(1;122) = 3.85$, $p < .052$
- Grade $F(1;122) = 5.31$, $p < .023$

Grade 9 analysis:
- Task (Reading vs writing) $F(1;93) = 1.96$, $p < .165$

Grade 11 analysis:
- Task (Reading vs writing) $F(1;92) = 3.05$, $p < .084$
- Passage $F(2;92) = 2.88$, $p < .061$

Table 6

Relationships between Words Written during Study Task and Posttest Performance

	Essay Quality	Multiple-Choice Comprehension	Gain in Passage Knowledge	
			Immediate	Four-Week
Adjusted within Cell Correlation	.274 (df=96)	.146 (df=99)	.255 (df=98)	.354 (df=98)

Table 7

Supplementary Reading, Four Weeks

	No. of Passages	Within-Cell SD	Adjusted Means: Notes Regular	Notes Suppl.	Reading Regular	Reading Suppl.
Grade 9	3	5.8	21.8	23.0	20.5	21.6
Grade 11	3	6.5	25.1	20.5	22.5	24.1
Pooled	2	5.9	21.0	19.2	18.9	21.7

Significant Effects (Task by Passage by Grade covaried on pretest passage knowledge)

Pooled analysis:

Task x Reading	$F(1;85) = 2.49$, $p < .118$
Task x Grade x Reading	$F(1;85) = 4.45$, $p < .038$

Grade 9 analysis:

No significant effects

Grade 11 analysis:

Passage	$F(1;68) = 1.75$, $p < .182$
Task x Reading	$F(1;68) = 2.49$, $p < .093$

Table 8

Characteristics of the Study Tasks

		Tasks			Passages	
		Read and Study (-)	Comprehension Questions (n=26)	Summary Writing (n=25)	Analysis Writing (n=25)	1 (n=40)	2 (n=36)
Words	M	-	132.2	149.5	117.4	150.5	113.6
	(SD)		(57.1)	(46.9)	(69.7)	(85.6)	(64.3)
T-units	M	-	17.8	12.3	8.8	15.3	10.5
	(SD)		(6.5)	(4.5)	(5.9)	(8.9)	(6.8)
Words/ T-unit	M	-	7.5	12.8	13.7	10.6	12.0
	(SD)		(2.0)	(3.1)	(3.1)	(3.8)	(3.9)
Content Words Included (%)	M	-	24.7	18.5	14.5	13.5	17.3
	(SD)		(12.4)	(7.2)	(8.1)	(10.0)	(13.5)

Analyses of Variance for Task and Passage Effects

		Effects							
	df error	Task (linear)		Task (deviations)		Passage		Interaction	
Variable		F	p	F	p	F	p	F	p
Words	70	0.26	ns	3.04	.086	7.56	.008	0.39	ns
T-units	70	29.13	.001	0.70	ns	9.14	.003	0.36	ns
Words/ T-unit	70	61.72	.001	11.73	.001	0.97	ns	1.24	ns
Content units	61	14.83	.001	0.35	ns	3.51	.066	3.18	.049

Table 9

Recall of Passage Content, Day 2

		Tasks				Passages	
		Read & Study (n=17)	Comprehension Questions (n=22)	Summary Writing (n=25)	Analysis Writing (n=19)	1 (n=43)	2 (n=40)
Percent Recalled	M	8.1	10.5	11.8	12.3	9.4	12.3
	(SD)	(6.3)	(6.0)	(5.4)	(5.3)	(4.8)	(6.3)
Recall by Levels of Passage Structure							
Top	M	7.8	14.1	14.8	11.9	12.4	12.7
	(SD)	(9.1)	(10.4)	(10.5)	(7.3)	(8.1)	(11.2)
Middle	M	10.9	10.9	11.5	13.4	8.3	15.3
	(SD)	(11.0)	(9.4)	(9.3)	(10.6)	(7.9)	(10.0)
Bottom	M	6.2	7.3	10.1	9.9	7.7	9.9
	(SD)	(6.7)	(5.9)	(5.3)	(7.5)	(5.2)	(7.2)
Recall by Manipulation							
Manipulated	M	-	32.2	39.6	49.9	39.3	41.0
	(SD)		(15.5)	(22.3)	(21.7)	(22.5)	(19.7)
Not manipulated	M	-	4.1	5.2	6.6	4.5	6.0
	(SD)		(3.4)	(3.2)	(5.1)	(3.2)	(4.6)

Analyses of Variance for Task and Passage Effects

	df error	Effects: Task (linear) F	p	Task (deviations) F	p	Passage F	p	Interaction F	p
Variable									
Recall	75	4.90	.030	0.33	ns	5.09	.027	0.03	ns
Top	75	1.68	.198	2.23	.115	0.02	ns	0.16	ns
Middle	75	0.46	ns	0.08	ns	10.52	.002	0.01	ns
Bottom	75	4.46	.038	0.42	ns	3.13	.081	1.01	ns
Manip.	60	8.13	.006	0.03	ns	0.02	ns	1.48	ns
Not manip.	60	3.60	.062	0.01	ns	1.72	.195	0.09	ns

Table 10

Recall of Passage Content, Day 5

		Tasks				Passages	
		Read & Study (n=22)	Comprehension Questions (n=22)	Summary Writing (n=17)	Analysis Writing (n=15)	1 (n=44)	2 (n=32)
Percent Recalled	M	6.3	8.3	9.7	9.1	7.6	9.1
	(SD)	(4.0)	(6.1)	(4.3)	(5.8)	(4.4)	(6.0)
Recall by Levels of Passage Structure							
Top	M	6.6	10.3	9.5	9.5	9.1	8.6
	(SD)	(6.4)	(7.4)	(7.2)	(8.5)	(5.7)	(9.0)
Middle	M	7.9	8.4	10.9	7.6	6.6	11.6
	(SD)	(7.2)	(8.6)	(6.8)	(8.8)	(5.4)	(9.1)
Bottom	M	4.4	5.8	9.0	8.1	6.8	6.3
	(SD)	(4.4)	(6.4)	(4.4)	(6.9)	(5.8)	(5.8)
Recall by Manipulation							
Manipulated							
	M	-	25.2	34.5	44.4	34.3	32.1
	(SD)		(18.6)	(18.8)	(24.2)	(22.7)	(20.0)
Not manipulated							
	M	-	3.9	4.3	4.2	3.4	5.1
	(SD)		(4.1)	(2.6)	(4.1)	(3.0)	(4.3)

Analyses of Variance for Task and Passage Effects

	df error	Task (linear)		Effects Task (deviations)		Passage		Interaction	
		F	p	F	p	F	p	F	p
Variable									
Recall	68	3.82	.055	0.59	ns	1.85	.178	1.11	ns
Top	68	1.24	ns	0.85	ns	0.01	ns	0.30	ns
Middle	68	0.12	ns	1.03	ns	8.26	.005	0.61	ns
Bottom	68	5.48	.022	0.64	ns	0.13	ns	1.44	ns
Manip.	48	8.81	.005	0.02	ns	0.03	ns	0.84	ns
Not manip.	48	0.06	ns	0.02	ns	2.62	.112	0.18	ns

Table 11

Ratings for Recalling the Gist of the Passage

	Tasks				Passages	
	Read & Study	Comprehension Questions	Summary Writing	Analysis Writing	1	2
Day 2						
Mean rating	1.94	2.13	2.44	2.45	2.34	2.19
(SD)	(.85)	(.83)	(.77)	(.89)	(.88)	(.80)
Percent rated "good"	18.8	31.8	36.0	60.0	43.2	30.7
n	16	22	25	20	44	39
Day 5						
Mean rating	1.90	2.05	2.39	2.20	2.14	2.09
(SD)	(.70)	(.65)	(.70)	(.78)	(.72)	(.71)
Percent rated "good"	19.0	22.7	38.9	40.0	28.9	29.0
n	21	22	18	15	45	31

Analyses of Variance for Task and Passage Effects (Mean ratings)

		Effects							
	df error	Task (linear)		Task (deviations)		Passage		Interaction	
Variable		F	p	F	p	F	p	F	p
Gist:									
Day 2	75	4.38	.040	0.25	ns	0.85	ns	0.36	ns
Day 5	68	2.76	.101	0.69	ns	0.01	ns	0.21	ns

Table 12

Mean Differences in Topic Specific Knowledge Scores

Change Scores:		Tasks: Unrelated Reading	Read and Study	Comprehension Questions	Summary Writing	Analysis Writing
Passage 1	n	50	14	15	12	11
Day 2	M	0.0	3.1	3.6	4.3	2.3
	(SD)	(4.2)	(3.2)	(3.5)	(5.6)	(3.6)
Day 5	M	0.5	0.1	- 0.8	- 2.8	0.0
	(SD)	(2.7)	(3.2)	(3.8)	(4.1)	(4.6)
Passage 2	n	52	12	12	15	11
Day 2	M	0.4	-0.3	3.4	3.7	4.6
	(SD)	(3.9)	(2.7)	(5.8)	(5.2)	(6.7)
Day 5	M	- 0.2	0.0	0.1	- 1.4	- 0.8
	(SD)	(2.5)	(2.3)	(4.1)	(4.3)	(2.4)

Analysis of Task Effects

	Passage 1 df	Passage 1 F	Passage 1 p	Passage 2 F	Passage 2 p
Multivariate	8;194	2.92	.004	2.20	.029
Univariate					
Day 2	4;97	4.67	.002	3.88	.006
Day 5	4;97	2.49	.049	0.66	.622
Contrasts with Unrelated Reading					
Day 2					
Read and Study	1;97	6.20	.015	0.25	.618
Comprehension Quest.	1;97	8.96	.003	4.18	.044
Summary Writing	1;97	10.87	.001	6.10	.015
Analysis Writing	1;97	2.81	.097	7.68	.007
Day 5					
Read and Study	1;97	0.12	.723	0.05	.825
Comprehension Quest.	1;97	1.76	.187	0.10	.758
Summary Writing	1;97	9.24	.003	1.84	.178
Analysis Writing	1;97	0.20	.653	0.37	.542

Notes

Results from separate MANOVAs for Passage 1 and Passage 2 topic knowledge scores, with 5 task conditions and 2 dependent variables for each analysis.

Day 2 scores are calculated as day 2 minus pretest; day 5 scores are calculated as day 5 minus day 2.